out, is depicted in the accompanying drawings, in which

FIGURE 1 is a cross-sectional view of the improved instrument;

FIGURE 2 is an enlarged cross-sectional view along line 2—2 of FIG. 1;

FIGURE 3 is a view of the valve during the passage through it of an illustrative mass or particle;

FIGURE 4 is an enlarged cross-sectional view along the line 4—4 of FIG. 3;

FIGURE 5 is a view similar to FIG. 3 as the mass leaves from the outlet end; and

FIGURE 6 is a fragmentary cross-sectional view of the lower part of the valve and enclosing chamber, showing a modification.

The chest wall is diagrammatically represented at **10.** Inserted through it, by usual surgical techniques, is a drainage tube **11** whose inner end is provided with one or two apertures **12** through which air and fluid and other matter may enter the tube **11.**

The outer end **13** of the catheter **11** is connected in leakproof fashion to a connection nipple **14** extending outwardly from, and preferably formed as an integral part of, the end wall **15** of a chamber **16** composed of rigid plastic or the like. The chamber **16** has been shown in the form of a substantially cylindrical body. Its other end wall **17** carries a connector tube **18** to which flexible discharge tubing **19** may be joined. The tube **19** leads, optionally, to a collection receptacle such as a flexible plastic bag or the like, or to a suction apparatus such as that customarily employed for chest drainage purposes. The end walls **15** and **17** may be permanently bonded or sealed to the body of the chamber **16**, or one or both of them may be separately attached, if desired, as by screw threads or the like. The body of the chamber **16** is preferably transparent so that the valve within it may be readily observed.

The end wall **15** of the chamber **16** has an inwardly projecting connection nipple **20** which is also preferably formed as an integral part of the wall **15.** This nipple is aligned with the outer connection nipple **14**, and it is connected in leakproof fashion to the rear or inlet end **21** of a tubular one-way valve element. This element consists of a substantially tubular body having opposed walls **22** of resilient rubbery material. The walls are separated at the inlet end **21** of the tube where they encircle and engage with the part **20**, but thereafter the walls **22** lie in flattened-together condition (see FIG. 2) all the way to the lower or outlet end **23.** By their inherent resilience the walls **22** are urged yieldably into this overlying relationship, thus establishing a normally closed passage through the valve. The walls **22** are in contact over a broad surface and keep the valve reliably closed against reverse flow. Under a slight pressure differential, the walls **22** spread apart momentarily, along an area dictated by the magnitude of the substance passing through, as indicated in FIGS. 3 and 4, thus allowing passage of air and fluid and other matter through the valve and out of the outlet end **23** into the lower part of the chamber **16** surrounding it. It will be noted that the inner walls of the nipples **14** and **20** diverge toward the valve **22.** This structure inherently permits any clot that enters the nipple **14** to pass through the nipple **20** and valve **22.** Furthermore, the cross-sectional shape of each wall of nipple **14** tapers in a direction away from valve **22** so that almost no ledge at all is present within the catheter upon which a clot might become lodged.

The valve is of adequate width to allow passage of the drainage material to be anticipated. This width may be approximately one inch. The valve is also of appreciable length, viz., of the order of three inches. This length is considerably greater than that of any particle or mass likely to pass through the valve.

The chamber which surrounds the valve is only slightly larger in diameter, as shown in FIG. 2. It extends longitudinally for a distance slightly greater than the length of the rubbery tube as shown in FIG. 1.

The catheter **11** may be of rubber or plastic and of conventional size and character, and the discharge tubing **19** is similarly of conventional kind appropriate to the function it is to perform. It is not essential that the connection of the tubing **19** to the outlet on the chamber **16** be leakproof.

A slight modification is illustrated in FIG. 6, in which the valve element happens to be shown as it appears from a direction at 90° from that of FIGS. 1, 3 and 5. The modification resides in the fact that the outlet connector pipe or tube **18** is located at the side of the protective chamber rather than at the end. The chamber **16′** has a closed end wall **17′** so that a small body of water may be accommodated, into which the lower or outlet end of the valve extends. The outlet pipe **18′** is located, as shown, above the level **24** of this water.

The operation is as follows: the upper end of the intrapleural catheter **11** is of course connected to the chest cavity in leakproof manner. The valve walls **22** are normally in fully contacting relation so that the passage through the valve is closed, hence no air can enter the chest cavity through the tube **11.** During the patient's normal breathing procedure, the lung moves periodically toward the chest wall **10**, thus developing a temporary buildup of air pressure in the tube **11.** As each pulse rises above atmospheric pressure, the walls **22** of the valve are forced open momentarily, and air and fluid are expelled through it. As substances pass through the valve, the walls **22** partake of a kind of peristaltic movement as indicated in FIGS. 2, 3 and 5. A gob or particle of matter **25** (which may be liquid or solid or in-between) exerts a mild pressure upon the convergent region of the valve walls **22** as shown in FIG. 2; the walls separate momentarily in advance of the substance, then come together again directly behind it. The substance thus works its way gradually and progressively through the valve until it is discharged as shown in FIG. 5.

The representation of FIGS. 3 and 4 depicts an intermediate stage during the progressive movement of the mass or body **25.** It will be observed that the instrument can be employed with absolute safety to the patient. Because of the substantial length of the valve relative to the size of solid or semi-solid masses likely to pass through it, no body such as that indicated at **25** can ever cause a malfunctioning in which the valve is in a dangerous open condition. Even if a mass such as that shown at **25** were to become stuck, there are always surrounding areas of substantial size in which the walls **22** are pressed together and thus seal off the valve against perilous reverse flow of air or liquid.

Thus the chest is continuously drained, while re-entry of air is assuredly precluded. Whether the patient is lying, sitting, or moving about, the valve is protectively shielded by the chamber **16** that surrounds it, and the expelled material may be accumulated in an appropriate bag or receptacle connected to the tube **19.** Should it become necessary or desirable to establish connection with conventional suction apparatus, the tube **19** can be simply disconnected from the portable collecting bag and connected, instead, to the suction apparatus.

The construction shown in FIG. 6 is useful in indicating, by the occurrence or absence of bubbling, the extent to which the chest drainage is progressing. In post-operative periods it is desirable to observe this.

It is to be understood that minor structural changes may be made without necessarily departing from the spirit and scope of the invention as expressed in the appended claims.

What is claimed is:

1. An instrument for drainage of the chest, comprising a one-way valve composed of a tubular element of rubbery material one end of which is an inlet and the other an outlet, the inlet being adapted to be connected in leakproof fashion to the outlet end of an intrapleural catheter, the walls of the tubular element lying apart at